WiRe Link: RF506-900

Features:

- Compact design
- Lightweight
- Low power consumption
- Basic or Advanced operation modes
- Programmable options, via I^2C interface
  - ♦ Tx or Rx mode
  - ♦ Auto or manual channel selection
  - ♦ Network ID assignment
  - ♦ Initiation group assignment by ID
- Discrete and digital outputs
- Device status indicator LED

Model: RF506-900

RF506-900 enclosure and mounted on EID1-TW-M/CB

Applications:

- Aerial Testing
  - ♦ Programmable parachute disreefing
  - ♦ Drogue or main parachute release
  - ♦ Multiple event sequencing
- Timing Synchronization
- Remote Switch

General Description:

The **Wi**reless **Re**efing (WiRe) Link[1] is a radio communications device that creates a network between two or more host devices by transmitting and receiving data packets via radio frequency signals. The WiRe Link transmitter generates a personal area network with which receiver devices automatically associate, becoming a network node. The individually addressed radio nodes securely communicate commands and supporting data across the network with the base transmitter. Paired with **E**lectronic **I**nitiation **D**evices (EID), the WiRe Link radios enable parachute disconnect and disreefing events to be wirelessly commanded from a payload-mounted transmitter. Handheld transmitters can be used to arm or safe test articles remotely while maintaining personnel safe-zones.

RoHS

[1] Hardware, functionality, and/or use applications are protected by one or more patents.

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Rev 10/24

SPECIFICATIONS:

ELECTRICAL

Power Supply:	3.6v - 6v DC, regulated on-board to 3.3v DC Reverse polarity protected 6.5 volt Absolute Maximum Rating
Enable/Stby:	< 0.6v for Standby state >1.8v to Enable output 6.5 volt Absolute Maximum Rating
Current Draw:	Standby: < 1 µA nominal Running: 30 mA nominal average Indicating: LEDs upto 60 mA average
Output Switch:	Isolated contacts, normally open analog switch control Voltage maximum to follow power supply

ENVIRONMENTAL

Temperature:	-40°C to 85°C Operating -55°C to 150°C Storage
Humidity:	15 - 85% RH, non-condensing

MECHANICAL

Connectors:	Sullins: SBH21-NBPN-D05-RA-BK (10pin interface) Mates with SFH213-PPPN-D05-ID-BK Molex: 503471-0200 (output switch) Mates with 503473-0200
Dimensions:	Board only: 1.59" x .68" x .40" [40.4 mm x 17.3 mm x 10.1 mm] Enclosure: 2.08" x .84" x .52" [52.8 mm x 21.3 mm x 13.2 mm]
Weight:	< 1 oz. nominal, ~24 g epoxy sealed within enclosure

OPERATIONAL

Wireless:	Paired transmitter with maximum of 24 receivers Range: ≥300 feet Typical actuation time <13 ms
Node Setup:	Transmitter/Receiver and Basic/Advanced mode select Automatic or manual channel selection (1-10) Network PAN ID selection (1-65519) Initiation group assignment (1-24)
Node Initiation:	Discrete logic level output signal (basic mode) I^2C encoded command (advanced mode only)
Initiation Data:	I^2C encoded data (advanced mode only) Node debug data (radio metrics) EID or host data (host metrics)
Communication:	Serial data via header and TTL level adapter (for updates only)

PART NUMBER REFERENCE

RF506-900

Product Model

RF Frequency

900 = US & Canada 902-928 MHz
800 = Europe 868-868.6 MHz
700 = China 779-787 MHz

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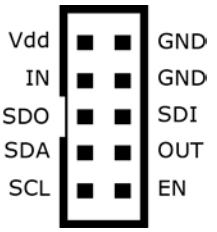
PIN CONFIGURATIONS:

Electrical interface header:



On-board connector, Sullins P/N: SBH21-NBPN-D05-RA-BK
Mating connector, Sullins P/N: SFH213-PPPN-D05-ID-BK

- 1.Vdd - Supply voltage, 5v typical, 10v maximum
- 2.GND - Common ground with supply voltage
- 3.IN - Buffered input 5.5v maximum
- 4.GND - Common ground with supply voltage
- 5.SDO - Serial data output, 3.3v TTL levels
- 6.SDI - Serial data input, 3.3v TTL levels
- 7.SDA - I^2C data line, 5.5v maximum
- 8.OUT - Discrete output signal at Vdd voltage level
- 9.SCL - I^2C clock line, 5.5v maximum
- 10.EN - Power supply enable/standby input at Vdd voltage level

Optional on-board locking connector, Harwin P/N: M80-8511045
Optional mating connector, Harwin P/N: M80-8881005

Switched contacts (n/o) connector:

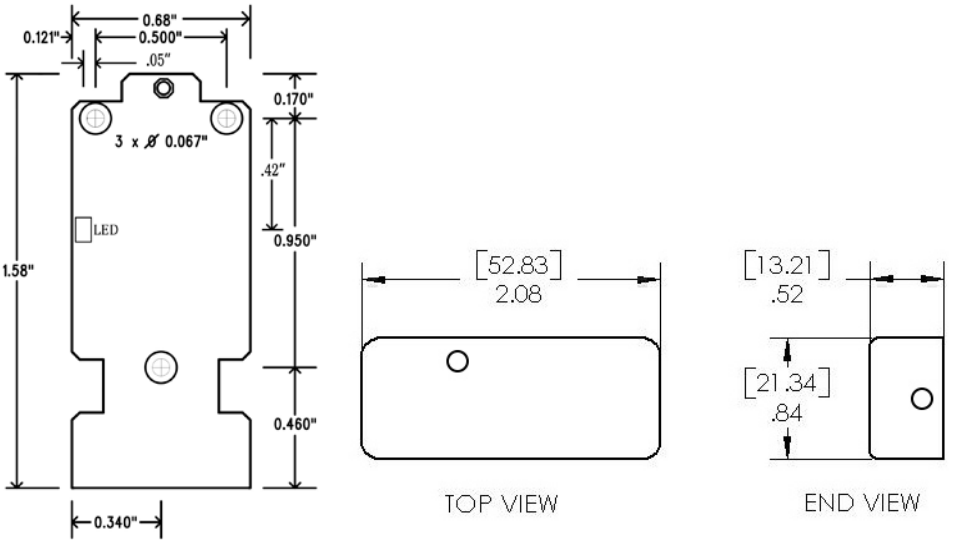
On-board connector, Molex P/N: 503471-0200
Mating connector, Moles P/N: 503473-0200

- 1.CMN - Switch common node
- 2.NO - Switch wiper node, normally open

DEVICE DESCRIPTIONS: Dimensions in inches [millimeters] unless otherwise noted.

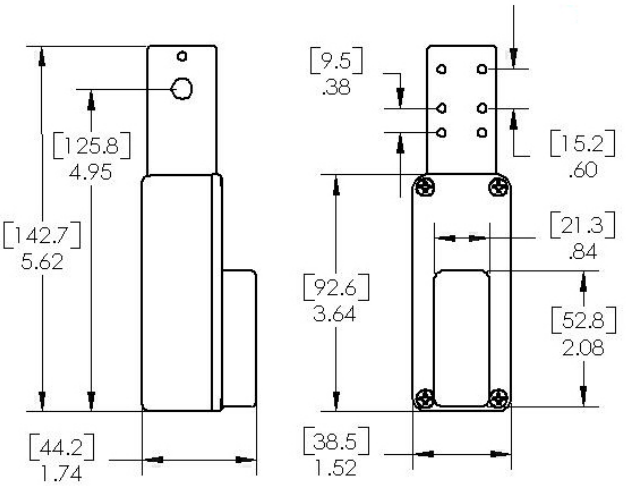
Circuit board and enclosure for attachment to EID1 (for reference only)

RF506-900 outline & mounting holes; Enclosure p/n: RFLC1



Example of RF506-900 attached to EID1 enclosure (for reference only)

Model EID1-xW-M/CB (CB2-RRLG4 @ L1, RFLC1 on lid)



DEVICE OPERATION:

LED Indications

The WiRe Link devices have the following LED indications of operation status. The indications are listed in an order that is likely to be seen during nominal operation; however every listed indication may not be seen or in the described sequence.

Device operating as a Transmitter:
Power enabled…
2 short flashes – clear/quiet channel found/chosen
Long flash every second – no RCVRs associated
Short flash every 500ms – Status Pings being sent to RCVRs
Short flash every 125ms – Initiation Commands being sent to RCVRs
Short flash every 2 seconds – all RCVRs echoed Initiation Command
Long flash every 2 seconds – all Post Initiation data downloaded from RCVRs

Devices operating as a Receiver:
Power enabled...
Long flash every second – no XMTR found or XMTR signal lost
2 short flashes – associated to a XMTR
Short flash every 125ms – Initiation Commands being received from XMTR
Short flash every 2 seconds – all Post Initiation data sent to XMTR

Operational Flow

Basic Mode

- Power-up
- Node operation begins
  - Transmitters begin listening for receiver's requests to join the network
    - Double short LED flash indicates an operating channel has been selected
  - Receivers begin scanning for transmitters and send requests to join the network
    - Double short LED flash indicates association with transmitter
  - Searching for signal from other nodes indicated by long LED flash once every second
- Automatic association between transmitters and receivers
  - Occurs only between radio nodes with matching PAN ID
  - Periodic status pings maintain link; or association restarts if signal is lost
    - Short LED flash once every ½ second indicates successful echo of status ping
- Initiation command
  - Host device triggers transmitter node via discreet buffered input signal
    - Input signal is pulsed (requires 4 pulses in <1 ms, ~7.8 kHz)
    - Input signal is asserted (requires 5th rising edge in <1ms to begin handshake)
    - Transmitter node responds by asserting Output signal
    - Host device de-asserts Input signal

        - Transmitter node de-asserts Output signal (handshake ends)
    - Command sent wirelessly to associated receiver nodes
        - Receiver nodes reply to transmitter with acknowledgement of command
        - Quick LED flash once every ⅛ second indicates successful transmit or receipt of initiation command
    - Receiver nodes trigger host device via discrete output signal
        - Output signal is pulsed (outputs 4 pulses in <1 ms, ~7.8 kHz)
        - Output signal is asserted (outputs 5th rising edge in <1ms to begin handshake)
        - Host device responds by asserting Input signal
        - Receiver node de-asserts Output signal
        - Host device de-asserts Input signal (handshake ends)
- Post-Initiation
    - Receivers assert output signal indicating all wireless transmission are complete
    - Transmitters assert output signal indicating all wireless transmissions are complete
- Power-down

Advanced Mode

- Power-up
- Programming period - 100 millisecond wait
    - If no data received - no change to data stored in register
    - If new Node Setup data received via I^2C - overwrite previous data stored in register
    - If invalid data - overwrite previous data stored in register with default values
        - Error indicated by LED solid on with ~⅛ second off period once every second
- Node operation begins - based on data stored in Node Setup register
    - Transmitters begin listening for receiver's requests to join the network
        - Double short LED flash indicates an operating channel has been selected
    - Receivers begin scanning for transmitters and send requests to join the network
        - Double short LED flash indicates association with transmitter
    - Searching for signal from other nodes indicated by long LED flash once every second
- Automatic association between transmitters and receivers
    - Occurs only between radio nodes with matching PAN ID
    - Periodic status pings maintain link; or association restarts if signal is lost
        - Short LED flash once every ½ second indicates successful echo of status ping
- Initiation command
    - Host device triggers transmitter node via discreet buffered input signal and I^2C
        - Input signal is asserted
        - I^2C write data to Initiation register
        - Initiation register data is compared to Node Setup register data for validation
        - Transmitter node responds by asserting Output signal
        - Host device de-asserts Input signal
        - Transmitter node de-asserts Output signal (handshake ends)
    - Command sent wirelessly to associated receiver nodes (of first receiver group ID)
        - Receiver nodes reply to transmitter with acknowledgement of command

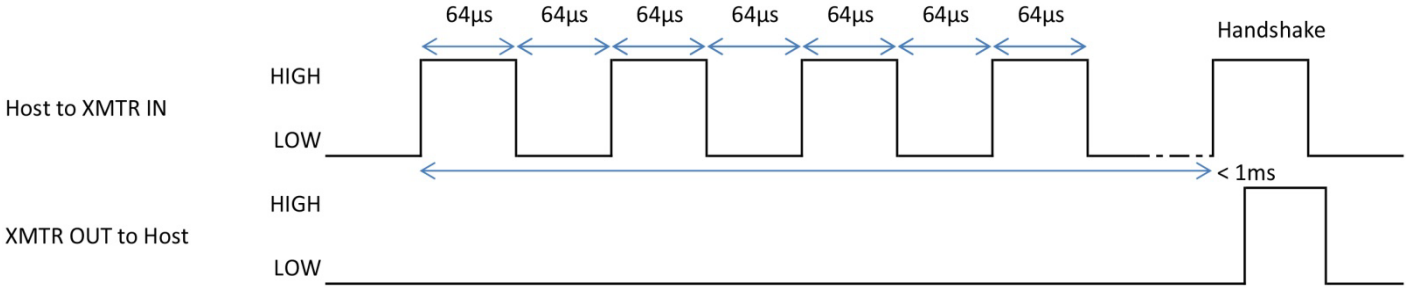
        - Quick LED flash once every ⅛ second indicates successful transmit or receipt of initiation command
    - Receiver nodes trigger host device via discrete output signal and I^2C
        - Output signal is asserted
        - Output signal assertion indicates to host device to perform I^2C read
        - I^2C read data from Initiation register
        - Initiation register data is compared to Node Setup register data for validation
        - Host device responds by asserting Input signal
        - Receiver node de-asserts Output signal
        - Host device de-asserts Input signal (handshake ends)
    - Receiver node accepts post-initiation data from host device via I^2C
        - Host device performs I^2C write to Post-Initiation register
- Subsequent Initiation command (skip if only one group of receivers)
    - LED indication returns to indicating status pings between sequential initiations
    - Possible only if multiple receiver groups exist, transmitter node triggered via I^2C
        - I^2C write data to Initiation register
        - Initiation register data is compared to Node Setup register data for validation
        - Transmitter node responds by asserting Output signal
        - Host device de-asserts Input signal
        - Transmitter node de-asserts Output signal (handshake ends)
    - Command repeated wirelessly to associated receiver nodes of specified group ID
        - Receiver nodes reply to transmitter with acknowledgement of command
        - Quick LED flash once every ⅛ second indicates successful transmit or receipt of initiation command
    - Receiver nodes trigger host device via discrete output signal and I^2C
        - Output signal assertion indicates to host device to perform I^2C read
        - I^2C read data from Initiation register
        - Initiation register data is compared to Node Setup register data for validation
        - Host device responds by asserting Input signal
        - Receiver node de-asserts Output signal
        - Host device de-asserts Input signal (handshake ends)
    - Receiver node accepts post-initiation data from host device via I^2C
        - Host device performs I^2C write to Post-Initiation register
- Data retrieval
    - Transmitter node requests post-initiation data from each receiver node
    - Receiver node wirelessly transfers post-initiation data to transmitter node for storage
        - Receiver sends full dataset for advance mode nodes
        - Receiver sends 'radio debug' data, and receiver host data (if available)
    - Host device accepts post-initiation data from transmitter node via I^2C
        - Output signal is asserted as indication to host device to perform I^2C read
            - Reading before data is indicated as ready may give zeroed data
        - Host device performs I^2C read from Post-Initiation register
- Power-down

COMMUNICATION PROTOCOLS:

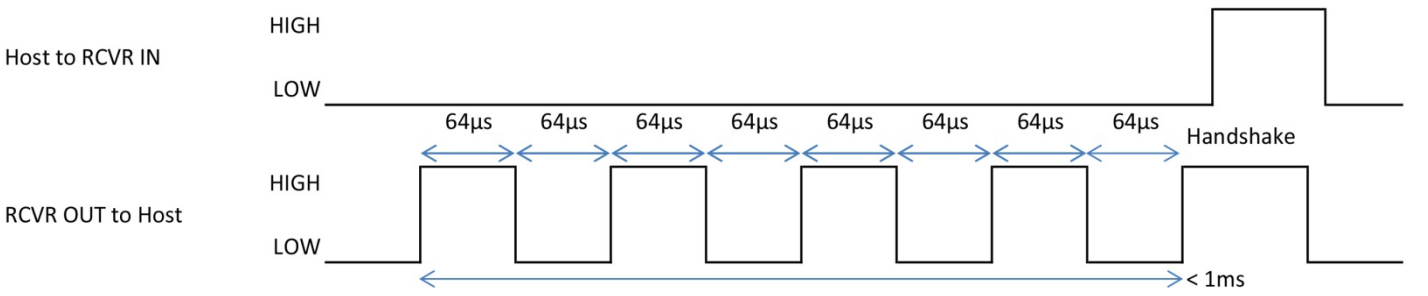
Basic Operations Mode

The WiRe Link device defaults to the Basic Operations Mode which employs only the discrete level input and output signals to communicate with the host device. The serial data and I^2C lines are not used in this mode and should not be connected.

The Input signal (**IN**) used in Basic Operations Mode requires a series of pulses in order to trigger the wireless initiation command, ending with an I/O handshake. The input pulse signal is sent from a host device to a transmitter WiRe Link device. The pulse signal from the host device begins low, then transitions through four cycles (low-high, high-low) at 7812 Hz, and must end high within 1ms from the first transition to begin the signal confirmation handshake (see Figure below). If the 4th transition low-high is acknowledged by the transmitter WiRe Link within the 1ms window, the wireless initiation command is sent to associated receiver WiRe Link devices. The 5th transition low-high begins the signal handshake, which continues by the transmitter WiRe Link device asserting its Output signal (OUT). The host device recognizes the Output signal (OUT) as confirmation then must pull low the Input signal (IN). The WiRe Link device completes the handshake by pulling low the Output signal (OUT).



The Output signal (**OUT**) used in Basic Operation Mode supplies a series of pulses to indicate a wireless initiation command, ending with an I/O handshake. The output pulse signal is sent from a receiver WiRe Link device to a host device. The pulse signal from the receiver node begins low, then transitions through four cycles (low-high, high-low) at 7812 Hz, and ends high within 1ms from the first transition to begin the signal confirmation handshake (see Figure below). The 5th transition low-high within the 1ms window is recognized by the host device as the initiation command and must acknowledge by asserting the IN signal. The receiver WiRe Link device responds by pulling low its OUT signal. The host device completes the handshake by pulling low the IN signal.



Advanced Operations Mode

2-wire Serial Interface Bus (TWI or I2C)

The 2 wire serial interface (I^2C) is well suited for connecting the WiRe Link to other microcontroller devices. A WiRe Link device connected to the bus lines occupies three (3) slave device addresses and maintains compatibility with other uniquely addressed devices on the bus lines. Detailed technical data on the I^2C protocol employed by the radio module's OEM Atmel® (as TWI) can be reviewed in their document number 2549.

The WiRe Link device operates as a slave device with all I^2C communications initiated by the host device operating as master. The WiRe Link device has three (3) data registers that utilize I^2C addresses: Node Setup, Initiation, and Post-Initiation. The least significant bit of each address is used as the read/write bit, per standard I^2C protocol. Unless otherwise noted, the use of a sub-address is not required; therefore the first byte following the register address is treated as data.

Node Setup Register

The Node Setup register contains configuration bytes that define the WiRe Link device operation. The register is accessed via I^2C at the slave address 0x7A (hex).

Reading data from the Node Setup address recalls the most recently written values. Writing data to the Node Setup address stores the new configuration bytes in memory.

The data stored in memory is loaded at 100ms after power-up and defines the device operation. An I^2C write must begin within the first 100 ms following power-up in order to immediately be loaded and define the device operation. Any data write occurring after 100 ms is stored in memory but will not go into effect until the next power cycle.

Any data bytes determined to be invalid while loading will result in storage of default values to the register memory. The error condition is indicated by a specific red LED illumination, as defined in LED Indications. A power cycle following an error, without writing new data, loads the stored default values and the device operates nominally without indicating an error.

SETUP ADDR	PAN ID	NODE TYPE	NODE CTRL	INITIATION CODE	# RCVR GROUPS	RCVR QTY#1	RCVR QTY#2	...	I^2C STOP
Byte 0	Byte 1-2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8		

Byte 0 SETUP ADDR: slave address for node setup data register
0x7A (hex) to write, 0x7B (hex) to read

Byte 1-2 PAN ID: personal area network identifier
16 bit value in range 0x0001-0xFFEF (hex), **default = 0x414C**
Value must match for transmitter and their intended receivers

Byte 3 NODE TYPE: node function set as transmitter/receiver in basic/advanced mode
0x00 (hex) = Basic Transmitter (data disabled)
0x08 (hex) = Advanced Transmitter (data enabled)
0x01 (hex) = Basic Receiver, **default = 0x01** (data disabled)
0x09 (hex) = Advanced Receiver (data enabled)

0x80 (hex) or greater = Data only, radio remains idle

Byte 4 NODE CTRL: node channel selection, 8 bit value
0x00 (hex) = use previous/current channel
0x01 through 0x0A (hex) = use corresponding channel number
0x0B through 0x1F (hex) = default, scan for and use quietest or transmitter chosen channel

Byte 5 INITIATION CODE: validation with host for data enabled nodes, 8 bit value
Must match for transmitter and their intended receivers, default = 0x5A

Byte 6 # RCVR GROUP: receiver group quantity or identity, 8 bit value
Transmitters: the quantity of groups of receiver nodes
Receivers: the group ID number of the particular receiver node

Byte 7 RCVR QTY#1: receiver node quantity, 8 bit value
Transmitters: the quantity of receiver nodes contained in group ID #1
Receivers: not used

Byte 8 RCVR QTY#2: receiver node quantity, 8 bit value
Transmitters: the quantity of receiver nodes contained in group ID #2
Receivers: not used

Byte 9+ RCVR QTY NXT: receiver node quantity of next (3rd, 4th,...) group, if present, 8 bit value
Transmitters: the quantity of receiver nodes contained in group ID #
Receivers: not used

Initiation Register

The Initiation register contains data bytes that define which group of WiRe Link receiver devices respond to initiation commands. The register is accessed via I^2C at the slave address 0x7C (hex).

Writing the appropriate eight (8) data bytes to the Initiation register of a transmitter device commences wireless transmission of the initiation command to all receiver devices associated with the specified group ID. The like-named data bytes must match those of the Node Setup register for all devices intending to be associated. Data written to a transmitter device in excess of the first eight (8) bytes will be ignored, as well as data written to a receiver device; however the devices will acknowledge each byte per I^2C protocol.

Reading the first eight (8) data bytes from the Initiation register of a receiver device indicates whether that device has received the initiation command via wireless transmission. The first eight (8) data bytes in the register remain zeroed until after having received the initiation command. Upon receipt of the initiation command, the receiver device appropriately populates the first eight (8) data bytes and also asserts the discrete output signal labeled OUT, which is used as an interrupt to the host device to read the Initiation register. The host device connected to the receiver device should compare the data read from the Initiation register to the expected data for determining subsequent action.

INIT ADDR	INITIATION CODE	# RCVR GROUP	QTY IN GROUP	PAN ID	FUTURE USE	FUTURE USE	FUTURE USE	I^2C STOP
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4-5	Byte 6	Byte 7	Byte 8	

Byte 0 INIT ADDR: slave address for node initiation data register
0x7C (hex) to write, 0x7D (hex) to read

Byte 1 INITIATION CODE: validation with host for data enabled nodes, 8 bit value
Must match for transmitter and their intended receivers, **default = 0x5A**

Byte 2 # RCVR GROUP: initiation receiver group identity, 8 bit value
The group ID number of the particular receiver group being commanded/initiated

Byte 3 RCVR QTY#1: receiver node quantity, 8 bit value
The quantity of receiver nodes contained in group being commanded/initiated

Byte 4-5 PAN ID: personal area network identifier, 16 bit value
16 bit value in range 0x1-0xFFF8 (hex), must match for transmitter and their intended receivers

Byte 6-8 FUTURE USE: reserved for future use, 8 bit values
Default = 0x00

Post-Initiation Register

The Post-Initiation register contains read-only performance data from the previous initiation command. The Post-Initiation register is accessed via I^2C at the slave address 0x7E (hex).

The Post-Initiation data consists of 64 bytes from a WiRe Link device and 64 bytes from its EID host, for a total of 128 bytes per dataset. The dataset from the local radio (transmitter or receiver) and its EID host are always stored in the first indexed location (index = 0) of the Post-Initiation register. The transmitter device wirelessly requests and downloads datasets from the remote radio (receivers) and their EID host (only after an initiation command). Each dataset is stored in indexed memory blocks of 128 bytes, in order of association with the network, up to a maximum of 24 receiver devices.

Reading data from the Post-Initiation register is done in blocks of 128 bytes. The first read returns data starting at index = 0. A full I^2C stop followed by again reading from the Post-Initiation register address of 0x7E (hex) returns data starting at index = 1. The remaining datasets are read in the same manner, with the index auto-incrementing upon each I^2C stop. After reading all occupied datasets, reading the next dataset returns all zeros, and the I^2C stop resets the index to index = 0.

Index = 0:

I^2C START	POST-INIT ADDR	LOCAL / XMTR DATA (64B)	LOCAL / XMTR DATA (64B)	I^2C STOP

Index = 1: (transmitter devices only)

I^2C START	POST-INIT ADDR	REMOTE NODE #1 DATA (64B)	REMOTE HOST #1 DATA (64B)	I^2C STOP

Index = 2: (transmitter devices only)

I^2C START	POST-INIT ADDR	REMOTE NODE #2 DATA (64B)	REMOTE HOST #2 DATA (64B)	I^2C STOP

Index = 3+: (transmitter devices only)

I^2C START	POST-INIT ADDR	64B DATA = 0x00 (hex)	64B DATA = 0x00 (hex)	I^2C STOP

Index = 0...

NOTES:

FCC Compliance Statement

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device in accordance with the specifications in Part 15 of FCC rules. Changes or modifications to this product not authorized by ALD Systems Inc. could void the authority to operate the product.

This equipment must be installed such that the FCC ID label is visible, or if the label is not visible when installed inside another device then the outside of the device must also display a label referring to the enclosed equipment stating "Contains FCC ID: QXK506900" or any similar wording that expresses the same meaning.

The antenna used for this transmitter must not be co-located or operated in conjunction with any other antenna or transmitter.

FCC RF Radiation Exposure Statement
This device is a portable device that complies with FCC RF radiation exposure limits set forth for an Uncontrolled Exposure environment.
This device meets the requirements for SAR test exclusion at a distance of <5mm for a portable device with 100% duty cycle per KDB447498 D01 General RF Exposure Guidance v05r0.

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